

## Research Article

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# Application of Garrett Ranking Method to Evaluate Soil Fertility Practices among Small and Marginal Farmers



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## ABSTRACT

The study utilized the dimension of soil fertility/land fertility to measure the agricultural performance of small and marginal farmers. Likert-type summated rating scale technique was employed to assess the practices adopted by these farmers to enhance their agricultural performance through soil fertility. Garrett's ranking technique was then utilized to rank the preference of respondents based on the most frequently adopted practices for soil fertility. The findings revealed that pre-plowing activity, stubble burning, deep plowing, and exposure to sun were the most frequently utilized practices by the respondents to improve soil fertility. This can be attributed to the small landholding size, low economic status, and indigenous knowledge of small and marginal farmers. The majority of the respondents have lower level of adoption of soil fertility practices. These findings contribute to easy understanding of the practices influencing soil fertility management among small-scale farmers and can inform the development of targeted interventions and support programs to enhance soil health in similar contexts.

**Keywords:** Garrett ranking, soil fertility and five-point continuum scale

## INTRODUCTION

Soil fertility is defined as the capacity of soil to support plant growth by supplying necessary nutrients, and by possessing suitable chemical, physical, and biological properties to serve as a favorable habitat for plant growth (Food and Agriculture Organization of United Nations). It is crucial for sustainable agriculture and is often maintained through the use of practices such as crop rotation; inter cropping, and the application of organic manure, vermicompost, pesticides, fertilizers and other soil amendments.

About 15 per-cent of plots received no soil fertility treatments, while 35 per-cent received a combination of inorganic fertilizer and manure. Maize yield was significantly influenced by soil fertility management, with the greatest impact by using a combination of inorganic fertilizer and manure. Using manure or compost alone had a moderate impact on yield [1].

An investigation conducted on smallholder farmers' knowledge on using bio-slurry as a soil fertility alteration input for potato production in Kenya. Results revealed that only 18 per-cent of farmers used bio-slurry, while 78 per-cent relying on chemical fertilizers and other manures. Challenges were reported with bio-slurry use, including a lack of knowledge on the exact quantity to apply and storage of excess slurry. Nearly 36 per-cent of the farmers used bio-slurry due to its availability and

cost-effectiveness compared to chemical fertilizers. Adoption was limited due to challenges while application and storage [6]. A study conducted on soil fertility status of forage-growing soils of Yadadri Bhuvanagiri district, Telangana. Yadadri Bhuvanagiri district soils were mostly alkaline with low organic carbon content, but some pockets have high levels (13.3%). Electrical conductivity ranges from 0.06-1.14 dSm<sup>-1</sup>, with high calcium content. Nitrogen was low in almost all samples, while available phosphorus was high in 49.4 per-cent and medium in 29.3 per-cent of samples, indicating 21.3 per-cent of soils have medium to high phosphorus levels. Zinc deficiency was present in 9.4 per-cent of samples, while Cu and Mn were sufficient and Fe is deficient in 10.6 per-cent of soils [5].

Based on the literature review it can be inferred that majority of the farmers were utilizing chemical fertilizers to enhance soil fertility. Some farmers were practicing combination of inorganic fertilizer and manure; also had a greatest impact on soil fertility but using manure or compost alone had a moderate impact on yield. As there were no previous studies on the application of the Garrett ranking method for assessing practices aimed at improving land fertility, the current study was undertaken to identify the best practices adopted by farmers to enhance their land fertility.

## Materials and methods

The study was conducted in the Bhadradri Kothagudem and Mulugu districts of Telangana state. A Likert-type summated rating scale technique was followed for development of a scale with a five-point continuum ranging from "very frequently", "frequently", "occasionally", "rarely" and "never", with scoring of 5,4,3,2 and 1 respectively. The scale was used to collect primary data from 300 small and marginal farmers, with 150 farmers

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from each district by using a simple random sampling technique to assess the frequency of various practices adopted to improve soil fertility. The level of practices adopted to improve the land (Soil) fertility was measured by using obtained maximum and minimum scores of each statement.

**Application of Garret's ranking method** To find out the most significant factor which influences the respondent, Garrett's ranking technique was used. Respondents were requested to assign the rank to all the statements, these ranks were then converted into score values using the following formula:

**Percent position =  $100(R_{ij} - 0.5)/N_j$**  Where:

$R_{ij}$  = Rank given for the  $i$ th statement by  $j$ th respondents

$N_j$  = Number of statements ranked by  $j$ th respondents

Percent position score was calculated using percent position formula. This score was then used to determine the Garrett score. The Garrett ranking technique was applied to assess the rate of adoption of soil fertility practices. The prime advantage of this technique over simple frequency distribution is that it arranges the practices based on respondents' preferences. It is commonly used to rank statements based on respondent ratings, which were subsequently converted into specific ranks. These responses were ranked using the Garrett ranking technique based on the frequency levels such as "very frequently, frequently, occasionally, rarely and never" with corresponding rankings of 1,2,3,4 and 5 respectively. The purpose of this ranking was to determine the most crucial agricultural practice adopted by farmers to enhance soil fertility. To convert these ranks into percentage, percent position formula should be used.

The ranking of each statement was converted into points using the Garrett table [4]. This conversion involved assigning points based on the per cent position of each rank. The resulting value, denoted as  $R_{ij}$ , was then multiplied by the corresponding Garrett value to obtain the total Garrett score. Subsequently, the average Garrett score was calculated by dividing the total Garrett score by the number of statements. The statement with the highest average value was considered the best-ranking option.

**Table 2 Distribution of respondents based on preference and ranking of practices adopted to increase the land (Soil) fertility in Bhadradi Kothagudem district (N=150)**

S. No.	Statements	1st		2nd		3rd		4th		5th	
		F	%	F	%	F	%	F	%	F	%
1	Growing fodder crops	14	9.33	5	3.33	8	5.33	1 2	8.00	11 1	74.0 0
2	Penning	5	3.33	4	2.67	8	5.33	1 4	9.33	11 9	79.3 3
3	Farm yard manure	46	30.67	14	9.33	12	8.00	2 0	13.3 3	58	38.6 7
4	Pre plough	142	94.67	5	3.33	-	-	3	2.00	-	-
5	Deep plough and expose the soil to sun	83	55.33	44	29.33	11	7.33	4	2.67	8	5.33
6	Inter - cropping with legumes	5	3.33	13	8.67	15	10.0 0	8	5.33	10 9	72.6 7
7	Soil test based fertilizer recommendation	-	-	-	-	-	-	6	4.00	14 4	96.0 0
8	Crop rotation with legumes	9	6.00	-	-	8	5.33	-	-	13 3	88.6 7

**Table 1 Percent position and Garrett value for soil/ land fertility**

S. No.	Percentage position	Calculated value	Garrett value
1	$100(1-0.5)/12$	4.17	83
2	$100(2-0.5)/12$	12.5	73
3	$100(3-0.5)/12$	20.83	66
4	$100(4-0.5)/12$	29.17	61
5	$100(5-0.5)/12$	37.5	56

The Garrett ranks were calculated by using appropriate Garrett ranking formula. Based on the Garrett ranks i.e. 1 to 5, the Garrett value was obtained from the standard Garrett table. In Table 2, the scores of each statement in the soil fertility dimension were multiplied by the obtained Garrett value from Table 3. These resulting scores were recorded in Table 3. By summing up each row in Table 3, the total Garrett scores were obtained and presented.

## Results and Discussion

The practices adopted and followed by the respondents related to improve soil fertility to enhance agricultural performance were discussed below.

Table 2 revealed that, majority (95%) of the respondents in Bhadradi Kothagudem district ranked 1<sup>st</sup> in adopting the pre-ploughing activity, followed by 2<sup>nd</sup> rank (3%) and 4<sup>th</sup> rank (2%). In terms of adopting stubble burning activity, majority (85%) of the respondents were ranked 1st, while only 3 per cent were ranked least. Deep ploughing and exposure to sun was ranked 1<sup>st</sup> by 55 per cent of the respondents and least ranked by 5 per cent. However, practices such as organic farming, soil test based fertilizer application and stubble mulching were ranked least by 99 per cent, 96 per cent and 94 per cent of the respondents respectively.

9	Organic farming	-	-	-	-	1	0.67	-	-	14 9	99.3 3
10	Green manure	1	0.67	2	1.33	6	4.00	1 5	10.0 0	12 6	84.0 0
11	Stubble- mulching and incorporation	1	0.67	-	-	1	0.67	7	4.67	14 1	94.0 0
12	Stubble burning	128	85.33	14	9.33	1	0.67	2	1.33	5	3.33

From the table 3 it was observed that, pre-plowing activity was adopted by most of the respondents in Bhadradri Kothagudem district with mean score of 82.23 and ranked in first place as most of the people were familiar about it and easy access to mechanical ploughs, followed by stubble Burning stood in second rank with a mean score of 80.76 which may be due to quicker, easier and cost-effective practice. Accordingly, deep plowing and exposure to sun was ranked third with mean score of 76.79 as people were well aware about it. Majority i.e. cent per-cent of the farmers practiced deep summer plowing activity [7]. Biofertilizers along with practices like crop rotation, tillage maintenance, and crop residue recycling, enhances soil fertility [9].

**Table 3 Calculation of Garret Value and Ranking of practices adopted to increase the land (Soil) fertility by the respondents in Bhadradri Kothagudem district (N=150)**

S. No	Statements	Ranks given by the respondents					Total score	Mean	Rank
		1st	2nd	3rd	4th	5th			
1	Growing fodder crops	1162	365	528	732	6216	9003	60.02	5
2	Penning	415	292	528	854	6664	8753	58.35	7
3	Farm yard manure	3818	1022	792	1220	3248	10100	67.33	4
4	Pre plough	11786	365	-	183	-	12334	82.23	1
5	Deep plough and expose the soil to sun	6889	3212	726	244	448	11519	76.79	3
6	Inter - cropping with legumes	415	949	990	488	6104	8946	59.64	6
7	Soil test based fertilizer recommendation	-	-	-	366	8064	8430	56.20	11
8	Crop rotation with legumes	747	-	528	-	7448	8723	58.15	8
9	Organic farming	-	-	66	-	8344	8410	56.07	12
10	Green manure	83	146	396	915	7056	8596	57.31	9
11	Stubble- mulching and incorporation	83	-	66	427	7896	8472	56.48	10
12	Stubble burning	1162	1022	66	122	280	12114	80.76	2

However, practices like organic farming, soil test based fertilizer application and stubble mulching were ranked least with mean score of 56.07 (XIIth Rank), 56.20 (XIth Rank) and 56.48 (Xth Rank), respectively. Respondents stated that adoption of these practices require high investment.

Table 4 showed that, majority (92%) of the respondents in Mulugu district ranked 1st in adopting pre-plowing activity, followed by 2nd rank (8%). In terms of adopting stubble burning activity, majority (57%) of the respondents were ranked 1st, followed by 2nd rank, 3rd rank and 4th rank by 31 per cent, 12 per cent and one per cent respectively. Deep plowing and exposure to sun was ranked 1st by 58 per cent of the respondents, followed by 2nd rank (40%) and 3rd rank and 4th rank by one per cent each. However, practices such as organic farming, soil test based fertilizer application and stubble mulching were ranked least with 99 per cent, 96 per cent and 94 per cent of the respondents respectively.

**Table 4 Distribution of respondents based on preference and ranking of practices adopted to increase the land (Soil) fertility in Mulugu district (N=150)**

S. No.	Items	1st		2nd		3rd		4th		5th	
		F	%	F	%	F	%	F	%	F	%
1.	Growing fodder crops	1	0.67	4	2.67	2	1.33	19	12.67	124	82.67
2.	Penning	1	0.67	1	0.67	3	2.00	47	31.33	98	65.33
3.	Farm yard manure	24	16.00	6	4.00	30	20.00	45	30.00	45	30.00
4.	Pre plough	138	92.00	12	8.00	-	-	-	-	-	-

5.	Deep plough and expose the soil to sun	87	58.00	61	40.67	1	0.67	1	0.67	-	-
6.	Inter - cropping with legumes	1	0.67	-	-	2	1.33	2	1.33	145	96.67
7	Soil test based fertilizer recommendation	1	0.67	1	0.67	9	6.00	42	28.00	97	64.67
8.	Crop rotation with legumes	4	2.67	-	-	-	-	-	-	146	97.33
9.	Organic farming	1	0.67	-	-	1	0.67	1	0.67	147	98.00
10.	Green manure	2	1.33	-	-	11	7.33	30	20.00	107	71.33
11.	Stubble- mulching and incorporation	-	-	-	-	-	-	2	1.33	148	98.67
12.	Stubble Burning	85	56.67	46	30.67	18	12.00	1	0.67	-	-

Table 5 revealed that in Mulugu district, majority of the respondents were adopting pre-plowing activity with a mean score of 82.20 and ranked in first place. Deep plowing and exposing to sun with second rank, and stubble burning stood in the third rank with mean scores of 78.67 and 77.75, respectively. The results were in harmony with [7]

While discussing with the respondents, it revealed that pre-plowing is a common practice in the region, tolerance to water and improve crop yields. Deep plowing and exposing the soil to sun controls pests and weeds and improves soil fertility. Even though stubble burning is not a good practice, people preferred to burn the agricultural waste with in the field may be due to lack of awareness about it.

However, practices such as stubble mulching, organic farming, and intercropping with legumes were ranked least, with mean scores of 56.07, 56.28, and 56.38 and twelfth, eleventh and tenth rank respectively, this may be due to lack of knowledge or awareness about these practices and lack of farm yard manure. Majority (95.5%) of the farmers were using animal manure [8].

**Table 5 Calculation of Garret Value and Ranking of practices adopted to increase the land (Soil) fertility by the respondents in Mulugu district (N=150)**

S. No.	Items	Ranks given by the respondents					Total score	Mean	Rank
		1st	2nd	3rd	4th	5th			
1	Growing fodder crops	83	292	132	1159	6944	8610	57.40	8
2	Penning	83	73	198	2867	5488	8709	58.06	7
3	Farm yard manure	1992	438	1980	2745	2520	9675	64.50	4
4	Pre plough	11454	876	-	-	-	12330	82.20	1
5	Deep plough and expose the soil to sun	7221	4453	66	61	-	11801	78.67	2
6	Inter - cropping with legumes	83	-	132	122	8120	8457	56.38	10
7	Soil test based fertilizer recommendation	83	73	594	2562	5432	8744	58.29	5
8	Crop rotation with legumes	332	-	-	-	8176	8508	56.72	9
9	Organic farming	83	-	66	61	8232	8442	56.28	11
10	Green manure	166	-	726	1830	5992	8714	58.09	6
11	Stubble- mulching and incorporation	-	-	-	122	8288	8410	56.07	12
12	Stubble burning	7055	3358	1188	61	-	11662	77.75	3

Table 6 revealed that, majority (93%) of the respondents were ranked 1st in adopting pre-plowing activity, followed by 2nd rank (6%) and 4th rank (1%). In terms of adopting stubble burning activity, majority (71%) of the respondents were ranked 1st, followed by 2nd rank, 3rd rank and 5th rank and 4th rank by 20 per cent, 6 per cent and two per cent and one per cent of the respondents respectively. Deep plowing and exposure to sun was ranked 1st with 57 per cent, followed by 2nd rank (35%) and 3rd rank (4%), 5th rank (3%) and 4th rank (2%) by the respondents. However, practices such as organic farming, stubble mulching and crop rotation were ranked least with 99 per cent, 96 per cent and 93 per cent of the respondents respectively.

**Table 6 Distribution of total respondents based on preference and ranking of practices adopted to increase the land (Soil) fertility (N=300)**

S. No.	Items	1st		2nd		3rd		4th		5th	
		F	%	F	%	F	%	F	%	F	%
1.	Growing fodder crops	15	5.00	9	3.00	10	3.33	31	10.33	235	78.33
2.	Penning	6	2.00	5	1.67	11	3.67	61	20.33	217	72.33
3.	Farm yard manure	70	23.33	20	6.67	42	14.00	65	21.67	103	34.33
4.	Pre plough	280	93.33	17	5.67	-	-	3	1.00	-	-
5.	Deep plough and expose the soil to sun	170	56.67	105	35.00	12	4.00	5	1.67	8	2.67
6.	Inter - cropping with legumes	6	2.00	13	4.33	17	5.67	10	3.33	254	84.67
7	Soil test based fertilizer recommendation	1	0.33	1	0.33	9	3.00	48	16.00	241	80.33
8.	Crop rotation with legumes	13	4.33	-	-	8	2.67	-	-	279	93.00
9.	Organic farming	1	0.33	-	-	2	0.67	1	0.33	296	98.67
10.	Green manure	3	1.00	2	0.67	17	5.67	45	15.00	233	77.67
11.	Stubble- mulching and incorporation	1	0.33	-	-	1	0.33	9	3.00	289	96.33
12.	Stubble Burning	213	71.00	60	20.00	19	6.33	3	1.00	5	1.67

Based on the data presented in table 7, it can be observed that pre-plowing activity was ranked 1st with a mean score of 82.21, indicating that it was the most frequently adopted agricultural practice among the respondents as it is a common practice that helps to loosen the soil and prepare it for sowing. Stubble Burning was ranked 11th with a mean score of 79.25 due to its ease of implementation and low cost, despite its negative impact on the environment. Deep plowing and exposing to sun, which was ranked 3rd with a mean score of 77.73 as this might have been favored as it helps to kill the weed seeds and pests in the soil.

However, organic farming was stood in last place with twelfth rank by mean score of 56.17, indicating that it was the least frequently adopted practice among the respondents due to the high cost, unavailability of manures and technical knowledge required for its implementation. Stubble mulching and application of soil test-based fertilizer were ranked eleventh and tenth rank respectively, with mean scores of 56.27 and 57.25 since these were relatively newer and less familiar practices to the farmers. Maize-legume intercropping systems decrease nutrient loss and improve soil fertility mentioned by [2]. Majority (96%) of the respondents implemented recommended methods of sowing, time of fertilizer application, and crop rotation [3].

**Table 7 Calculation of Garret Value and Ranking of practices adopted to increase the land (Soil) fertility by total respondents (N=300)**

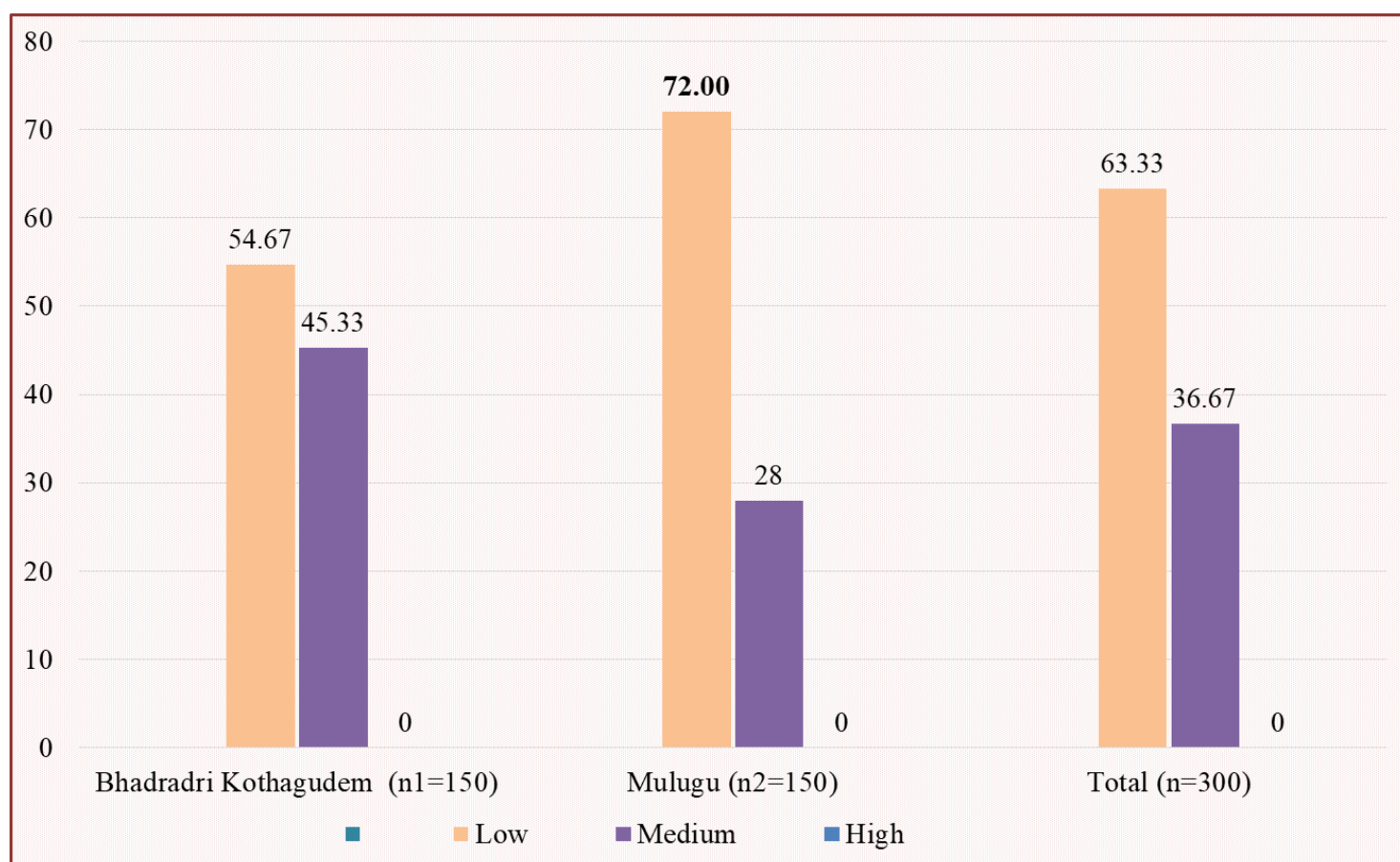
S. No	Statements	Ranks given by the respondents					Total score	Mean	Rank
		1st	2nd	3rd	4th	5th			
1	Growing fodder crops	1245	657	660	1891	13160	17613	58.71	5
2	Penning	498	365	726	3721	12152	17462	58.21	6
3	Farm yard manure	5810	1460	2772	3965	5768	19775	65.92	4
4	Pre plough	23240	1241	-	183	-	24664	82.21	1
5	Deep plough and expose the soil to sun	14110	7665	792	305	448	23320	77.73	3
6	Inter - cropping with legumes	498	949	1122	610	14224	17403	58.01	7



7	Soil test based fertilizer recommendation	83	73	594	2928	13496	17174	57.25	10
8	Crop rotation with legumes	1079	-	528	-	15624	17231	57.44	9
9	Organic farming	83	-	132	61	16576	16852	56.17	12
10	Green manure	249	146	1122	2745	13048	17310	57.70	8
11	Stubble- mulching and incorporation	83	-	66	549	16184	16882	56.27	11
12	Stubble burning	17679	4380	1254	183	280	23776	79.25	2

The maximum and minimum scores of land fertility were 60 and 12 respectively. Based on the inclusive class interval, the respondents were split into three categories: low, medium, and high.

From the fig.1 it was observed that, three categories based on obtained scores i.e. low (12 to 28), medium (28 to 44), and high (44 to 60) levels of practice. In Bhadradi Kothagudem district, more than half of the respondents had lower level of adoption of soil fertility practices, followed by a medium (45%) level of adoption. In Mulugu district, similar results were found i.e., majority (72%) of the respondents had a lower level of adoption, followed by a medium (28%) level of adoption of soil fertility practices.



**Figure: 1 District wise distribution of respondents by level of practices adopted to improve the land (Soil) fertility**

Overall data showed that, 63 per-cent of the respondents had a lower level of adoption of soil fertility practices, indicating that they found the cost of maintaining soil fertility by using organic manure and animal manure to be high. However, 37 per cent had a medium level suggesting that some people had animals and could use them as manure. The obtained mean and standard deviation scores were  $2.22 \pm 0.17$ .

## Conclusion

The present study aimed to identify the preference and ranking of practices adopted by the farmers to enhance soil fertility. The results showed that the most frequently adopted practices were pre-plowing activity, stubble burning and deep plowing, and exposure to the sun due to their cost-effectiveness, ease of use, and effectiveness in killing weed seeds and pests. Practices like organic farming, stubble mulching, and application of soil test-based fertilizer were poorly adopted, possibly due to the unavailability of manures and the low economic status of the farmers. Policy makers should focus on developmental programs regarding supply of organic manure at reasonable price and conduct awareness programs on soil fertility practices.

### Acknowledgment

We duly acknowledge the cooperation extended by the respondents without whom, this study would not have been possible.

**Conflicts of interest:** We do not have a conflict of interest as authors.

### Future scope of the study

- The same study can be conducted in another state.
- The same study can be conducted on large farmers with a huge sample size.
- The same study can be conducted on specific crop cultivators, such as cotton, wheat, and paddy farmers, etc.

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